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High Strength Magnesium Alloy Bars

高强度镁合金棒材

（English Translation）

（送审稿）

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National Standard of the People’s Republic of China

GB/T 38715—2020

Foreword

SAC/TC 243 is in charge of this English translation. In case of any doubt about the contents of the English translation, the Chinese original shall be considered authoritative.

The standard is drafted in accordance with the rules given in the GB/T 1.1-2009.

This standard was proposed by the China Nonferrous Metals Industry Association.

This standard was prepared by SAC/TC 243 State Administration of China for Standardization of Nonferrous Metals.

High strength magnesium alloy bars

1 Scope

This standard specifies the technical requirements, test methods, inspection rules and marking, packaging, transport, storage, quality certificates and order forms (or contracts) of high-strength magnesium alloy bars.

This standard is applicable to the extruded magnesium alloy round bars, square bars and hexagonal bars (hereinafter referred to as bars) with the ultimate tensile strength no less than 350 MPa at room temperature.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

GB/T 4297,Inspection method for macrostructure of wrought magnesium alloy products

GB/T 5153,Designation and composition of wrought magnesium and magnesium alloys

GB/T 5155-2013,Magnesium alloy extruded bars

GB/T6519-2013,Ultrasonic inspection of wrought aluminum and magnesium alloy products

GB/T 13748 (all parts),Chemical analysis methods of magnesium and magnesium alloys

GB/T 16865,Test pieces and method for tensile test for wrought aluminum and magnesium alloys products

GB/T 17432,Methods for sampling for analyzing the chemical composition of wrought aluminum and aluminum alloy

GB/T 20967,Non-destructive testing-Visual testing

GB/T 32792,Packing, marking, transporting and storing magnesium alloy wrought products

GB/T 37596-2019,Magnesium alloy forgings for aerospace

YS/T 627,Wrought magnesium and magnesium alloys rotundity ingots

YS/T 1036,The method of optical emission spectrometric analysis of magnesium rare earth alloys

3 Technical requirements

3.1 Classification

3.1.1 Designation, temper and dimension

Designation, temper and dimension of the bars shall conform to the requirements in Table 1. When the purchaser has other requirements of designations, tempers or dimension, it shall be negotiated between the supplier and the purchaser and specified in the order form (or contract).

Table 1 Designation, temper and dimension

|  |  |  |
| --- | --- | --- |
| Designations | Tempers | Dimension a /mm |
| VW75M, VW93M | T5 | ≤160 |
| VW83M | T5 | ≤100 |
| AQ80M | T6 | ≤160 |
| WN54M | H112 |
| VW84M, VW94M, VW84N | H112, T5 |
| VW92 | H112, T5, T6 | ≤50 |
| a Dimension of round bar stands for the diameter of the bar. Dimension of square bar and hexagonal bar stands for the diameter of inscribed circle of the bar. | | |

3.1.2 Marking

Marking of bars is expressed in the order of profile’s name, this standard serial number, designation, temper and dimension. Examples of markings are expressed as follows:

Example 1:

An order of bar for designation of AQ80M, temper of H112, dimension with 40 mm in diameter and with 3500 mm in length,is as follows:

Round bar GB/T 38715-AQ80M H112-Φ40×3500

Example 2:

An order of bar for designation of VW75M, temper of T5, dimension with 120 mm in inscribed circle diameter, precision of class A, unfixed hexagon bar, is as follows:

Hexagon bar GB/T 38715-VW75M T5-120-A

3.2 Quality

3.2.1 Raw material

Ingot used to produce high-strength magnesium alloy shall meet the composition and macrostructure requirements of the bar as specified in this standard, and other quality of ingot shall comply with YS/T 627.

3.2.2 Production process

The supplier shall adopt proper production equipment and extrusion process to effectively guarantee the quality of the bar, and the extrusion ratio should not be less than 6.

3.3 Chemical composition

The chemical composition of VW93M, VW94M, VW84N, WN54M and VW92 bars shall conform to provisions in Table 2, and the chemical composition of other alloy bars shall conform to GB/T 5153.

Table 2 Designation and compositions

| Alloy group | Designation | Composition(mass fraction)/% | | | | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Mg | Zn | Mn | RE | Gd | Y | Zr | Ag | Si | Fe | Cu | Ni | Others | |
| each | total |
| MgGdYZr | VW93M | Rem. | - | - | 0.02  ～  0.30Er | 8.0  ～  9.6 | 1.8  ～  3.2 | 0.3  ～  0.7 | 0.02  ～  0.50 | 0.02 | 0.02 | 0.005 | 0.003 | 0.01 | 0.1 |
| MgGdYZnZr | VW94M | Rem. | 0.8  ～  1.5 | - | - | 8.5  ～  9.5 | 3.5  ～  4.5 | 0.4  ～  0.7 | - | - | 0.005 | 0.005 | 0.005 | 0.02 | 0.3 |
| MgGdYNiMn | VW84N | Rem. | - | 0.6  ～  1.0 | - | 7.9  ～  9.0 | 3.5  ～  5.0 | - | - | 0.05 | 0.01 | 0.02 | 1.0  ～  3.0 | 0.02 | 0.2 |
| MgNiY | WN54M | Rem. | - | - | - | - | 4.5  ～  6.0 | - | - | 0.05 | 0.01 | 0.02 | 3.5  ～  5.0 | 0.02 | 0.2 |
| MgGdYZnNdZr | VW92 | Rem. | 1.6  ～  2.4 | - | 0.7  ～  1.4Nd | 8.8  ～  9.8 | 1.6  ～  2.4 | 0.4  ～  1.0 | - | - | 0.01 | 0.02 | 0.005 | 0.02 | 0.2 |

3.4 Allowable deviation of dimension

The allowable deviation of dimension of the bars shall be in accordance with the requirements of grade B in GB/T 5155-2013. If the deviation of dimension of other grade is required, it shall be negotiated between the supplier and the purchaser and specified in the order form (or contract).

3.5 Tensile properties at room temperature

The longitudinal tensile properties of the bars at room temperature shall conform to the requirements in Table 3. Bars with properties exceeding the requirements in Table 3 shall be negotiated between the supplier and the purchaser and specified in the order form (or contract).

Table 3 Tensile properties at room temperature

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Designation | Dimensiona  mm | Temper | Tensile strength *R*m  MPa | 0.2 % Proof stress *R*p0.2  MPa | Fracture elongation *A*  % |
| Not less than | | |
| AQ80M | ≤80 | T6 | 370 | 260 | 4.0 |
| ＞80～160 | T6 | 365 | 240 | 3.0 |
| VW75M | ≤80 | T5 | 430 | 350 | 5.0 |
| ＞80～160 | T5 | 350 | 250 | 3.0 |
| VW83M | ≤100 | T5 | 420 | 320 | 8.0 |
| VW84M | ≤65 | H112 | 380 | 270 | 9.0 |
| T5 | 460 | 360 | 3.0 |
| ＞65～160 | H112 | 360 | 230 | 9.0 |
| T5 | 440 | 350 | 3.0 |
| VW93M | ≤160 | T5 | 350 | 280 | 5.0 |
| VW94M | ≤80 | H112 | 360 | 280 | 10.0 |
| T5 | 400 | 310 | 8.0 |
| ＞80～160 | H112 | 350 | 260 | 8.0 |
| T5 | 380 | 300 | 5.0 |
| VW84N | ≤80 | H112 | 370 | 260 | 6.0 |
| T5 | 450 | 340 | 3.0 |
| ＞80～160 | H112 | 350 | 240 | 6.0 |
| T5 | 440 | 320 | 3.0 |
| WN54M | ≤80 | H112 | 370 | 280 | 10.0 |
| ＞80～160 | H112 | 350 | 260 | 6.0 |
| VW92 | ≤50 | H112 | 350 | 280 | 10.0 |
| T5 | 360 | 260 | 8.0 |
| T6 | 380 | 270 | 6.0 |
| a Dimension of round bar stands for the diameter of the bar. Dimension of square bar and hexagonal bar stands for the diameter of inscribed circle of the bar. | | | | | |

3.6 Macrostructure

3.6.1 Cracks, inclusions (including flux slag), pores, primary crystal segregation, shrinkage tail, coarse crystal ring and other defects which damage the continuity of metal are not permitted in the macrostructure of the bars.

3.6.2 Lamination with a depth of no more than half of the negative deviation of the thickness is permissible in the macrostructure of the bars. If no lamination is required, it shall be negotiated between the supplier and the purchaser and specified in the order form (or contract).

3.6.3 If the purchaser has requirements for macro oxide film, metal compound, and manganese compound, it shall be negotiated between the supplier and the purchaser and specified in the order form (or contract). The macro oxide film, metal compound, and manganese compound shall conform to 3.6 in GB/T 37596-2019.

3.7 Ultrasonic flaw detection

Ultrasonic flaw detection of the bar shall be in accordance with the requirements of grade A in GB/T 6519-2013. If other defect detection grades are needed, it shall be negotiated between the supplier and the purchaser and specified in the order form (or contract).

3.8 Appearance

3.8.1 The surface of the bars shall be clean. Defects such as cracks, corrosion spots and various intrusions, that affecting the application are not permitted.

3.8.2 Defects with the depth not exceeding the negative deviation, such as extrusion trail, dent, bruise, bubble, abrade, scratch, convex and concave, are permitted on the surface of the bars.

4 Test methods

4.1 Chemical composition

The chemical analysis of the bar shall be conducted in accordance with GB/T 13748 or YS/T 1036. GB/T 13748 shall be adopted for the arbitration analysis.

4.2 Dimension deviation

The dimensional deviation shall be measured with measuring instrument with the corresponding accuracy.

4.3 Tensile properties at room temperature

The test method of longitudinal mechanical property of the bars at room temperature shall be in accordance with GB/T 16865.

4.4 Macrostructure

The macrostructure test methods for the bars shall be in accordance with GB/T 4297.

4.5 Ultrasonic flaw detection

The test methods for ultrasonic flaw detection of the bars shall be in accordance with GB/T 6519-2013.

4.6 Appearance

The test methods of appearance of the bars shall be in accordance with GB/T 20967.

5 Inspection rules

5.1 Inspection and acceptance

5.1.1 The bars shall be inspected by the supplier to ensure that quality of the bars conforms to the requirements of this standard and the order form (or contract). The quality certificate shall be filled in.

5.1.2 The purchaser shall inspect the received bars in accordance with the provisions of this standard. In case of dispute of inspection results with the provisions of this standard and the order form (or contract), the dispute shall be submitted to the supplier in written form, and determination should be made through consultation between the supplier and the purchaser. Objections that belonging to the surface quality or external dimensions shall be filed within one month from the date of receiving the bars. Objections that belonging to other natures shall be filed within three months from the date of receiving the bars. If arbitration is needed, it shall be determined through consultation between the supplier and the purchaser.

5.2 Batch

The bars shall be submitted for acceptance in batches, and each batch shall consist of sections of the same designation, the same temper, the same dimensions, the same melting, the same heat treatment furnace and the same extrusion lot. The batch weight is not limited.

5.3 Inspection items

Before leaving the factory, each batch of bar materials shall be inspected for chemical composition, dimension deviation, tensile property at room temperature, macrostructure, ultrasonic inspection and appearance.

5.4 Sampling

The sampling of bar shall comply with Table 4.

Table 4 Sampling requirements

|  |  |  |  |
| --- | --- | --- | --- |
| Inspection items | Sampling rules | Requirement Clauses | Inspection  Clauses |
| Chemical composition | In accordance with GB/T 17432, and one sample is taken from each batch | 3.3 | 4.1 |
| Dimensional deviation | Inspected one by one | 3.4 | 4.2 |
| Tensile properties at room temperature | Sampling number shall be 10% of bars’ number in each batch, but not less than two samples. Each sample should be cut in the tail end of the selected extruded bar. | 3.5 | 4.3 |
| Macrostructure | Sampling number shall be 10% of bars’ number in each batch, but not less than two samples. Each sample should be cut in the tail end of the selected extruded bar. | 3.6 | 4.4 |
| Ultrasonic flaw detection | Inspected one by one | 3.7 | 4.5 |
| Appearance | Inspected one by one | 3.8 | 4.6 |

5.5 Assessment of inspection results

5.5.1 When the chemical composition of any sample is unqualified, the batch is unqualified.

5.5.2 When the dimension deviation is unqualified, the bar is unqualified.

5.5.3 When the tensile property of any sample is unqualified, reinspection shall be taken with double quantity of samples cut from the batch of the bars. If all the results of the repeated tests are qualified, the batch of products is qualified. If any of the samples in the reinspection is still unqualified, the batch of profiles is unqualified.

5.5.4 If the macrostructure of any sample is unqualified, it shall be as follows:

a) When the samples have unqualified cracks, oxide films, segregation of metal compounds and manganese compounds, the batch shall be scrapped.

b) When the samples have unqualified tail shrinking, coarse crystal ring, bright ring and lamination, it is allowed to reinspection after cutting off a certain length of the unqualified bar until qualified. Other bars shall be either inspected one by one and the qualified bars are delivered, or the profiles are cut with maximum unqualified length from the retest and then delivered. In case of other defects, the batch of profiles shall be negotiated by both parties.

5.5.5 When the ultrasonic flaw detection is unqualified, the bar is unqualified.

5.5.6 When the appearance is unqualified, the bar is unqualified.

6 Marking, packaging, transportation, storage and quality certificate

6.1 Marking

6.1.1 Product marking

6.1.1.1 The following marking shall be stamped in the front of the qualified bar (or a label with the following marking):

a) Stamp of the supplier's technical supervision department;

b) Designation;

c) Temper;

d) Dimension;

e) Batch number.

6.1.1.2 For the bars with accepted diameter more than or equal to 20 mm, the word “W” shall be marked in the end of the extrusion.

6.1.2 Packaging marking

Marking of the packaging box of the bar shall be in accordance with GB/T 32792.

6.2 Packaging, transportation and storage

6.2.1 Bars shall be oiled and packaged. If there are special requirements, it shall be negotiated between the supplier and the purchaser and specified in the order form (or contract).

6.2.2 Other requirements for the packaging, transportation and storage of bars shall be in accordance with GB/T 32792.

6.3 Quality certificate

Quality certificate shall be provided for each batch of profiles, which includes:

a) Supplier name, address, telephone, fax;

b) Product designation;

c) Designation;

d) Temper;

e) Dimension and accuracy levels;

f) Batch number;

g) Net weight and number of packages;

h) All inspection results;

i) Stamp of the supplier's technical supervision department;

j) This standard serial number;

k) Packaging date (or manufacturing date).

7 Order form (or contract)

The order form (or contract) of the profiles using this standard shall include:

a) Product designation;

b) Designation;

c) Temper;

d) Dimensions and allowable dimension deviation;

e) Net weight or number of packages;

f) Special requirements of purchaser:

——Special requirements for dimensional deviation;

——Special requirements for tensile properties;

——Special requirements for package;

——Other special requirements;

g) This standard serial number;

h) Others.